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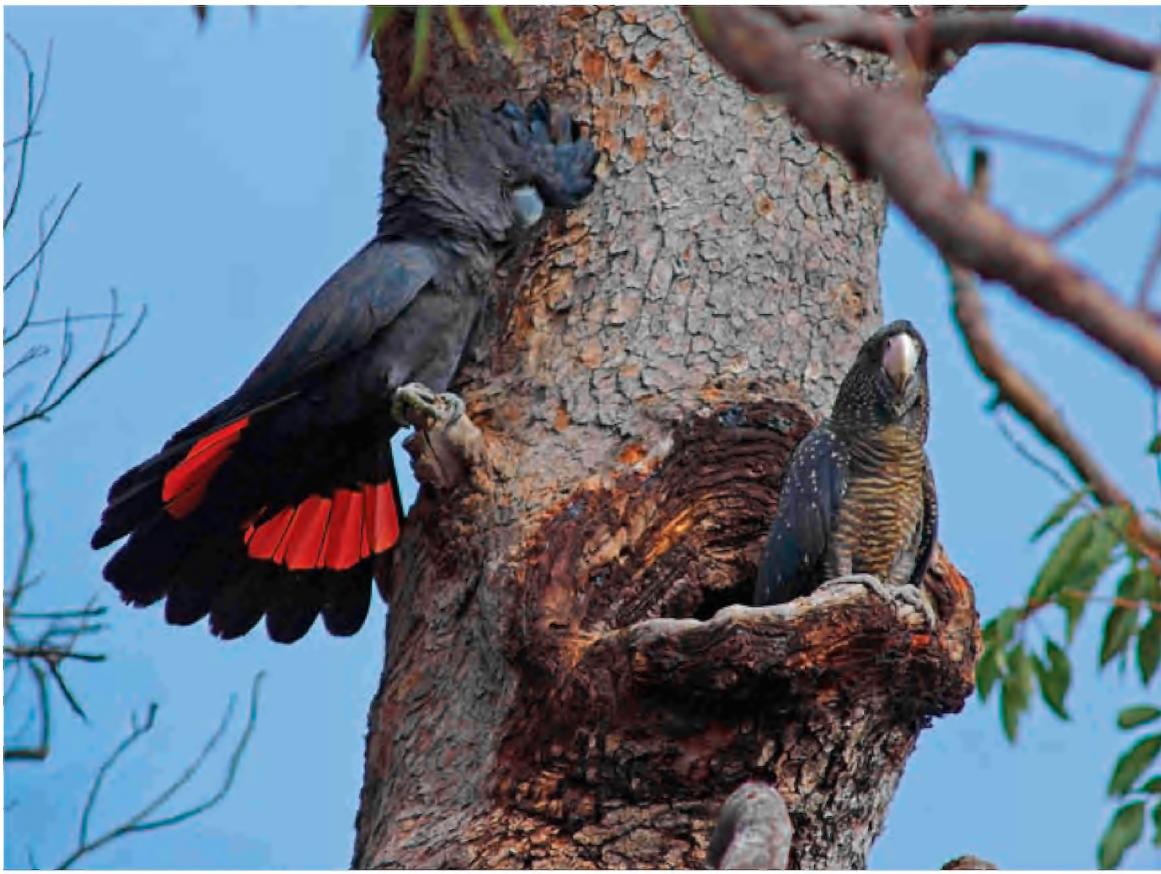

Adult male Forest Red-tailed Black Cockatoo (left) displaying to female (right) at nest hollow in Serpentine Hills.

Photo: T. Kirkby.

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THE DISTRIBUTION, STATUS MOVEMENTS AND DIET OF THE FOREST RED-TAILED BLACK COCKATOO IN THE SOUTH-WEST WITH EMPHASIS ON THE GREATER PERTH REGION, WESTERN AUSTRALIA

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ABSTRACT

The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) is a large, iconic forest cockatoo endemic to the south-west corner of Western Australia. It is listed as Threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Vulnerable under the Western Australian *Wildlife Conservation Act 1950*. It has experienced a severe decline in numbers and range since European colonisation. Over the past 20 years there has been a dynamic change in the foraging ecology of many birds in the northern Darling Range (adjacent to the Perth metropolitan area) driven mainly by their discovery of Cape Lilac as a new food source. Flocks that were once largely sedentary have now developed regular movements onto the Swan Coastal Plain and in some places have established new roost and breeding sites. Furthermore in 2014–2015 there was also a massive flowering and nutting of Marri (the main food throughout its range) in the northern Darling Range and on parts of the Swan Coastal Plain and during late 2015 and throughout 2016 there was a considerable movement of birds from the hills onto the southern Swan Coastal Plain to forage on Marri seed. Despite this abundance of food on the Swan Coastal Plain and in the adjacent hills region, almost no birds were recorded breeding in 2016, perhaps a result of

food quality rather than quantity, or perhaps a result of the energy required with the extensive movements to and from foraging sites. The availability of Jarrah and Marri seed is becoming increasingly scarce in many areas in the face of habitat modification, climate change and fire. The implications are that the Forest Red-tailed Black Cockatoo may become more dependent on some introduced species for food in some areas and this will impact on their breeding biology.

INTRODUCTION

The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) is a large, iconic forest cockatoo, endemic to the south-west of Western Australia. This subspecies occurs in the humid and subhumid south-west mainly the hilly interior, north to Gingin (formerly to Dandaragan), Gidgegannup, and east to Mount Helena (formerly Toodyay), Chidlow, Wooroloo, Wundowie, The Lakes, Christmas Tree Well, near Brookton, Bannister (formerly to Wandering), Mount Saddleback, Kojonup, Rocky Gully, the upper King River, Porongurup Range and Green Range. It was formerly common, but is now rare to uncommon and patchily distributed over most of its range. Its distribution on the northern Swan Coastal Plain was confined largely to the eastern zone north to Gingin and south to the Armadale-Byford and Serpentine -North Dandalup regions, with small breeding populations at Baldivis, Mundijong, Stake Hill, Karnup and more recently in the Perth area at Murdoch and possibly Perry Lakes.

It is listed as Threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as Schedule 3 fauna [species that are 'rare or likely to become extinct, as vulnerable fauna, are declared to be fauna that is in need of special protection'] under the Western Australian *Wildlife Conservation Act 1950*. It is currently the subject of a recovery program (Chapman 2008).

This paper provides details of the changing foraging ecology of many birds in the northern Darling Range over the past 20 years. The foraging ecology of some populations in the northern Jarrah-Marri forest in recent times has meant that flocks that were largely sedentary have now developed regular movements onto the Swan Coastal Plain and in some places established new roost sites and breeding sites. This movement has led to an erroneous impression in the Perth region that this subspecies is expanding its range and increasing in abundance.

DISTRIBUTION

The Red-tailed Black Cockatoo

Calyptorhynchus banksii (Latham, 1790) is widely distributed in eastern and northern Australia, and south-western Australia. In Western Australia there are three subspecies: *C. b. macrorhynchus* occurs in the Kimberley region; *C. b. samueli* in the mid-western region and *C. b. naso* from the far south-west of the State (Figure 1).

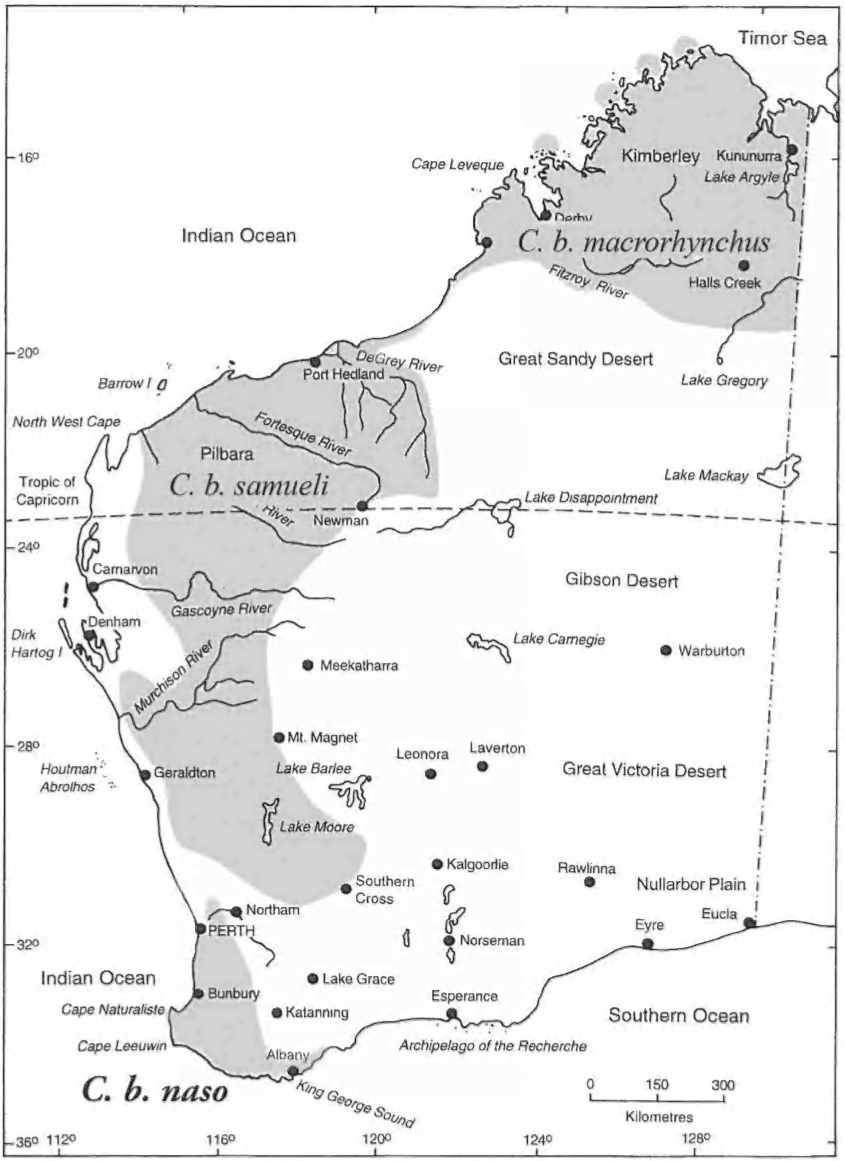

Figure 1. Distribution of Red-tailed Black Cockatoo subspecies in Western Australia.

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)

This subspecies occurs in the humid and subhumid southwest mainly the hilly interior, north to Gingin (casually e.g. December 1983 and Boonanarring November 2012), (formerly to Dandaragan), Guildford (resident here in colonial times now only rare or casual visitor, see below), Bindoon, Gidgegannup, and east to Mount Helena (formerly Toodyay), Chidlow, Wooroloo, Wundowie, The Lakes, Christmas Tree Well, Westdale, 10 km west of Brookton, North Bannister (formerly to Wandering), Mount Saddleback, Kojonup, Rocky Gully, the upper King River, Porongurup Range and Green Range (Figure 2). Masters and Milhinch (1974) noted it as scarce in the Northam district, only observed west of the Avon River each autumn in Wandoo forest at Glen Avon and west of Clackline in flocks up to

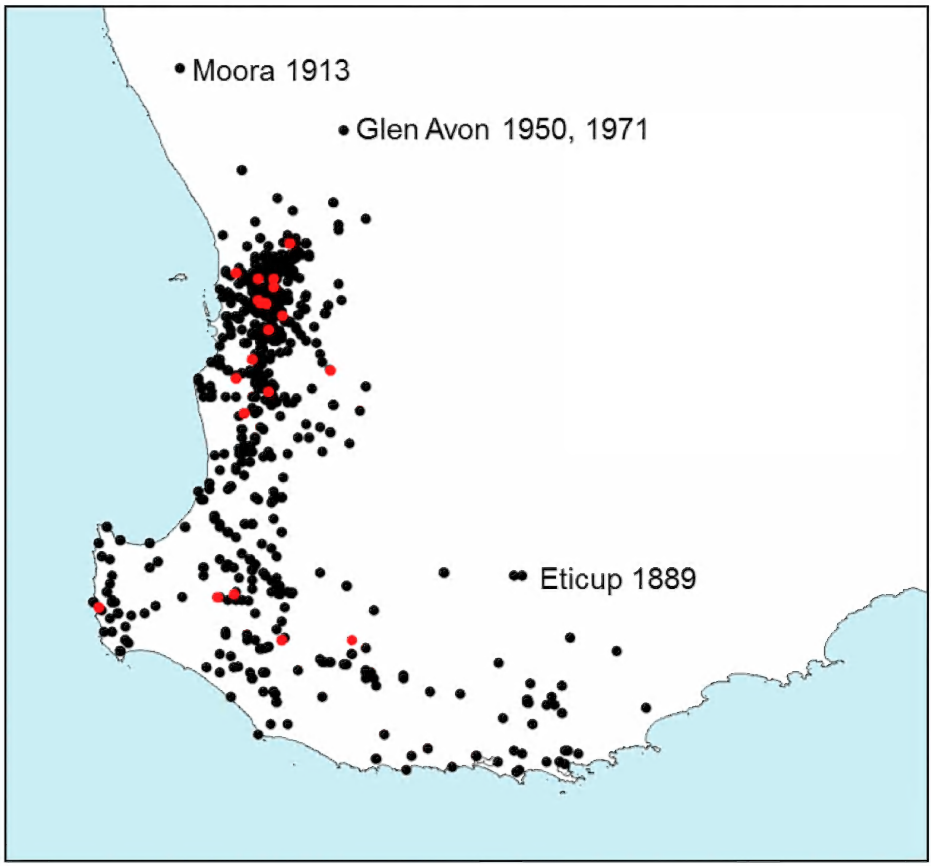

Figure 2. Distribution of Forest Red-tailed Black Cockatoo *C. b. naso* including historical records.

50; suddenly disappeared and last sighting was of five birds north of Clackline in 1971.

On the Swan Coastal Plain its status in historical times is uncertain. G.F. Moore noted a black cockatoo with a red tail about his homestead near Guildford in 1831. It was listed by Gould (1865) as "appears to be most numerous in the colony of the Swan River, where it inhabits all parts of the country". W.B. Alexander (1921) listed it for the Swan River District as "only occasionally seen in the district, being a bird of the inland regions of the State. The reasons for the occasional visits to coastal districts are unknown". Serventy (1948) noted that it was "never reported nowadays from the Swan Coastal Plain". Storr and Johnstone (1988) list it as a rare visitor in flocks up to 30, (November to May) to eastern parts of the Swan Coastal Plain, presumably from the adjacent Darling Range. On the Swan Coastal Plain it is currently rare, but resident at some sites (although patchily distributed) at Mundijong, Baldivis, Karnup, Stakehill, near Lake McLarty, Pinjarra, Coolup, Meelup, Goodale Sanctuary, Lake Clifton area, Dawesville and Wokalup (Storr-Johnstone Bird Data Bank).

Inland Red-tailed Black Cockatoo
(*Calyptorhynchus banksii samueli*)

This subspecies occurs in the western arid and semiarid regions of Western Australia, from the De Grey River south to Eneabba, Bindi Bindi, Wyalkatchem, Merredin, Walgoolan and Koolyanobbing and is a casual visitor further south at Kwolyin and Narembeen.

While the range of *C. b. naso* has contracted over the past 50 years, in comparison the range of *C. b. samueli* has expanded southwards and this may be continuing judging from southern records at Kwolyin, Narembeen and a recent report in September 2015 of a flock of five birds feeding in a paddock on the upper Darkin River (Westdale, Beverley Shire) within the range of *C. b. naso*.

MOVEMENTS AND CHANGES IN STATUS AND ABUNDANCE

The northern subspecies *samueli* is quite dispersive undertaking regular seasonal movements whereas *naso* on the other hand is considered generally very sedentary with strong fidelity to home range territory. In the past there has been some isolated vagrancy of pairs and small flocks onto the Swan Coastal Plain. For example a small flock was observed by A. Chapman at Lake Joondalup on 25 April 1977; two were observed by P. Griffin in Booragoon bushland on 27 May 1978; six observed drinking by J. Stuart at Rosalie Park (near Shenton Park) on 11 March 1981; and three seen by B. Gardiner over Guildford Grammar School in late April 1984.

Banding recoveries of 37 chicks that were banded between 1997

and 2011 with some 35 re-sightings of 11 birds (including fledglings to adults 13 years old) showed that juvenile-immature birds moved on average less than 3 km from their natal tree and older birds were recorded moving up to 19 km. For example a male chick banded at Nest 2 on 23 November 1997 was re-sighted ten times between January 1998 and November 2003 moving only 1–3 km from the nest site over that period and in July 2004 it was observed (with a female and immature) at Kelmscott six and a half years after banding and a distance of 6 km from the nest site. A male chick banded at Nest 18 in Bungendore Park (near Armadale) on 4 January 1998 was observed seven times between 6 April 1998 and 9 March 2003 moving between 0.2 and 3 km from its nest site. Another male chick, banded at Serpentine on 11 July 2000, was observed at Myara on 31 May 2013 and again on 3 July 2014 (13 and 14 years later) some 7 km from its nest site. Noteworthy also is a female banded as a chick in Nest 40 at Bungendore Park on 18 April 2002 that was observed four times in and around Bungendore Park between 2 June 2003 and 13 October 2005 (moving less than 3 km from the nest site) and on 15 July 2010 it was injured (after colliding with a car) at Lynwood a distance of 19 km from its natal area. Also a female banded as a chick in Nest 529 at Bungendore Park on 4 July 2009 was injured, and later died from vehicle strike at Carlisle on 29 January 2017 a distance of 24 km from its natal area. Another bird of interest is a male chick banded at Nest 47 at 31 Mile Road (Jarrahdale State Forest) in December 2003 was observed at Gleneagle on 29 August 2005 (a distance of 1.3 km) and observed in Bungendore Park on 21 March 2011, a distance of 14 km from its natal area.

Other banding records from Department of Parks and Wildlife include immature birds banded at Kaarakin Conservation Centre in Martin on 9 June 2009 and recovered at Araluen on 15 June 2009 after colliding with a vehicle (a distance of 7.1 km); another on 24 March 2011 and recovered at Manning after colliding with a vehicle on 5 June 2012 (a distance of 18 km); another banded on 27 July 2012 recovered at Wattle Grove after colliding with a vehicle on 2 August 2012 (a distance of 10.8 km).

Records suggest that Forest Red-tailed Black Cockatoos are generally sedentary. This sedentary nature of most flocks in the Perth Hills is backed up not only by banding but also by observations and photographs of a distinctive aberrant female with yellowish patches on nape and throat and two white outer primaries (Figure 3) observed at Cardup in February 2006, on Admiral Road in the Byford hills in August 2007 and near the same site in December 2007, January 2008, February 2008, August 2008, September 2008, November 2008, December 2008,

Figure 3. Aberrant female Red-tailed Black Cockatoo at Admiral Road, Byford.

March 2009, April 2009 and February 2011 and at Waterwheel Ridge estate, Bedfordale in 2015. The overall movement being less than 10 km during the period 2006–2015.

Further south, a Coolup resident, A. Robinson (1970), recorded small flocks leaving the heavily timbered Darling Range in 1970 and moving out onto the more open coastal plain which he noted as unusual.

FORAGING ECOLOGY

There are pronounced differences in the dimensions of the bill and in the food of the Forest Red-tailed Black Cockatoo *C. b. naso* and the more northern inland and mid-western subspecies *C. b. samueli*. The former *naso* has a large bill (and is mainly arboreal and the latter *samueli* has a small bill and feeds mainly on the ground.

Perth Region

Since 1995 there has been a very dynamic change in the foraging ecology of many birds in the northern Darling Range (adjacent to the metropolitan area). This began as a slow expansion of foraging range from the Darling Range, west onto the Swan Coastal Plain (mainly south of Perth) to foothill localities. Prior to this, sightings of banded birds (banded as nestlings) were within three km of banding site (natal tree). In the late 1990s small flocks and family groups began to alter their daily routine from foraging in relatively small home ranges within Jarrah-Marri forest to become at first only casual visitors to the base of the escarpment mainly exploiting fruiting Cape Lilac (*Melia azedarach*) in some of Perth's south-eastern suburbs e.g. Byford, Armadale, Kelmscott and Gosnells. By early 2000 this had extended further north and west as other feeding sites or opportunities were found in other suburbs including Thornlie, Lynwood, Queens Park, Cannington, Kewdale, Bentley, Belmont, Kensington and by 2005 this had extended further west and north to Murdoch and Kardinya, by 2007 north to Nedlands and west to Medina. By 2009 north to City Beach, Woodlands, Hamilton Hill, Mosman Park and Henley Brook, also west to Kwinana and by 2010 further north to Carine, Joondalup and the Upper Swan.

Also by early 2010 some of these flocks had established roost sites on the coastal plain and up to 30 birds were roosting in Lemon-scented Gum (*Corymbia citriodora*) at Murdoch, and by November numbers had increased to over 60. Small numbers (up to 5) were also roosting in the vicinity of Shenton Park bushland judging from some early morning observations. By 2011 over 100 birds were roosting in tall Lemon-scented Gum at Murdoch campus and up to 80 were roosting nightly in Marri in the western suburbs of Perth, near East Lake, Perry Lakes. During 2011–2012 numbers at the Perry Lakes roost would occasionally fluctuate from 0–80 birds (M. Owen pers. comm.) and at the same time numbers at Murdoch would increase with some counts of up to 200, so there was apparently some movement of birds between these roosts. By 2013 birds were regularly flying out from the scarp and visiting fruiting Cape Lilac trees as far west as Fremantle and Kwinana around 32 km from the Darling Scarp. On evening of 2 January 2017 over 266 birds were recorded in the Perry Lakes-Underwood Avenue area gathering to roost (M. Owen pers. comm.) This is the largest flock ever recorded on the Swan Coastal Plain. Since 2010 there has also been some vagrancy of flocks (probably driven by a lack of surface water in home ranges) east into the wheatbelt to areas where there was previously no historic records of Forest Red-tailed Black

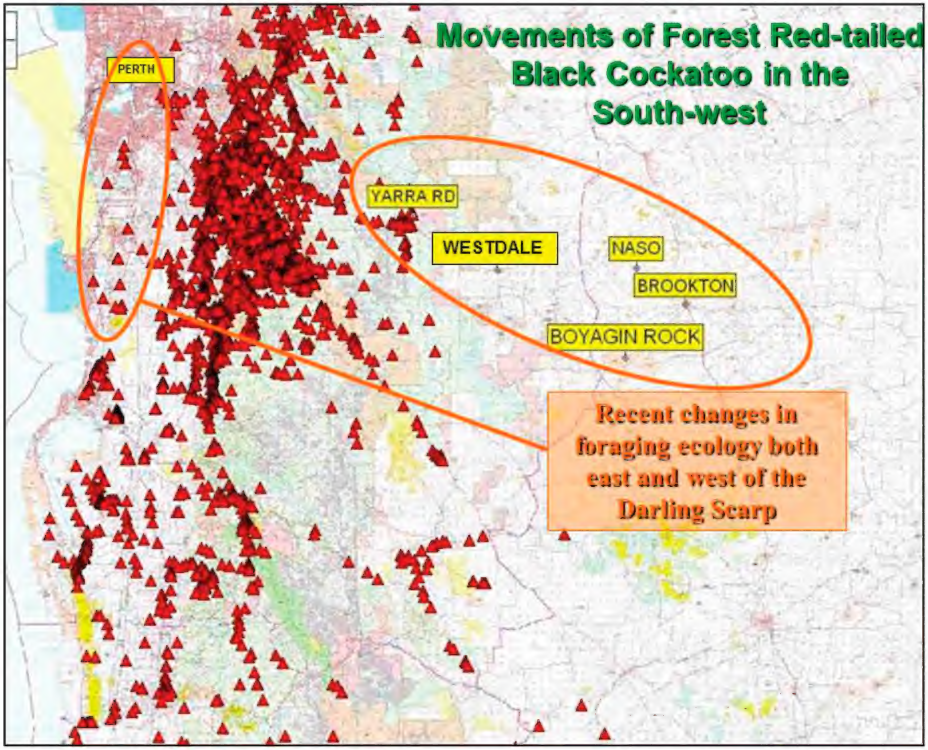

Figure 4. Occasional movements from the Darling Range eastwards into the wheatbelt towards Brookton and westwards onto the Swan Coastal Plain.

Cockatoos e.g. near Brookton and Boyagin Rock, see Figure 4.

Cape Lilac (*Melia azedarach*)

Cape Lilac (White Cedar, Persian Lilac), a native of Indomalesia and Australasia (variety in northern Australia), is a large, seasonally deciduous tree (generally 10–15 m, but up to 40 m) with a canopy 6–8 m wide. Trees in the south-west of Western Australia appear to be the Persian Lilac introduced from Asia (Mabberley and Pannell 2013). On the Swan Coastal Plain and especially in the Perth metropolitan area it is a common garden, park and farm tree grown mainly for its shade. It flowers in spring, just as the new leaves emerge, and flowering continues through into summer.

The marble-sized drupes (berry-like fruits) are produced from November to March in branched clusters 10–20 cm long, initially green then turning light yellow in colour at maturity. The leaves turn yellow in late autumn and fall in winter, but fruits remain on the tree all winter and gradually become wrinkled and more whitish. On the Swan

Figure 5. Adult male feeding on Cape Lilac in August at Fremantle.

Coastal Plain some trees with fruits can be seen throughout the year, including trees with both old (yellow) and new (green) fruits. From June to mid-September, most trees have lost their leaves and the yellow berry-like clusters are quite visible, see Figure 5.

The Inland Red-tailed Black Cockatoo *C. b. samueli* has been recorded feeding on the drupes of Cape Lilac at Merredin in the eastern wheatbelt of Western Australia since the mid-1990s (Stranger 1997) and at Dowerin in March 2001.

The first observations of the Forest Red-tailed Black Cockatoo foraging on Cape Lilac were from Bedfordale in August 1995 when some members of a small flock (nine birds) were seen feeding on ripe fruits. There was no evidence that birds had previously been feeding in these trees (i.e. no old or new debris below the trees) and some birds perched in the trees appeared uninterested in feeding while others began feeding at a rapid pace. Within two weeks most drupe clusters were gone from those trees and small flocks were foraging on nearby trees. These trees were within the home range of a large flock and the Cape Lilac trees were in a house garden at the edge of an orchard not typical habitat for Forest Red-tailed Black Cockatoo.

The movement onto the Swan Coastal Plain was initially very slow. Small flocks and family groups moving in early morning from roost sites near the western side of the Darling Range to areas at the foot of the range where they could forage on Cape Lilac and if the food resources were suitable discovering new sites often close by moving in a mosaic pattern. This opportunistic movement in populations that generally exhibit strong site fidelity was quite exceptional for this subspecies. This could be correlated with the decline in the availability or nature of Jarrah and Marri in the northern forest block or possibly an increase in the number of birds moving west to the edge of the escarpment from the drier eastern parts of the Darling Range. In the long term, however, many of these birds that are on the move could be condemned, through loss or change in their forest habitat, to become nomads and drifters to parts of the Swan Coastal Plain where food resources are also, or will eventually be, greatly limited. Around Perth many shires are removing Cape Lilac trees to control a pest caterpillar species of the White Cedar Moth (*Leptocneria reducta*) that is confined to these trees. Because of the limited amount of foraging habitat and the fact that birds quickly exhaust food supplies, seasonal fluctuations in numbers have been recorded at some roost sites including Murdoch and Perry Lakes.

We have recorded birds feeding on ripe Cape Lilac throughout the year. Trees close to the escarpment are stripped first and the birds generally start feeding in the canopy biting off the spray of fruits and then eating each fruit one at a time whilst holding the rest of the spray, see Figure 5. Experienced birds have been observed taking less than four seconds to remove the seed whilst immatures can take up to fifteen seconds. One banded bird fleshed ten fruits in 35 seconds. Once the canopy fruits are gone, the birds move to the lower branches. By the end of July most of the trees close to the escarpment have been stripped of fruits but many trees further west on the coastal plain (e.g. around Welshpool, Queens Park, Kensington) are still heavily loaded with fruit. At Armadale for example, birds begin visiting trees loaded with fruits in January and February and by the end of June most trees have been stripped of fruits and flocks are moving further north and west onto the coastal plain. Numerous trees with fruits are available on the Swan Coastal Plain throughout the year and birds have learned the location of these trees and return to the same trees year after year.

Noteworthy also is an apparent change in foraging behaviour with many of the birds visiting the Coastal Plain especially those around Murdoch, feeding on the ground (Figure 6), a behaviour that is rarely observed in the forest.

Figure 6. Forest Red-tailed Black Cockatoo feeding on the ground at Murdoch University.

The toxic principles and insecticidal qualities of the seeds, leaves and roots of Cape Lilac are discussed by Mabberley and Pannell (2013) – Cape Lilac fruit is toxic to pigs and humans (6–8 are a fatal dose in children). However, it is unknown what the long-term effects are (if any) of the foraging by Forest Red-tailed Black Cockatoos on Cape Lilac.

On 12 January 2012 a flock of ten birds was observed feeding in the canopy of Cape Lilac trees on Quarry Road in Hamilton Hill and another two were feeding on the ground below the trees.

This was in stark contrast with our observations in the forest where during the past 20 years of our study we have fewer than ten observations of birds feeding on the ground. This behaviour has also changed dramatically in 2016 with numerous observations of birds feeding on the ground either on fallen Marri seed or on nuts dropped by other species at Christmas Tree Well (Brookton Highway), Willowdale, Harvey, Myara, Mundijong and Serpentine. This is probably the result of a huge nutting cycle of Marri in 2015–16 with a considerable amount of seed falling onto the ground and many species such as Red-capped Parrots clipping nuts from trees that has enabled birds to forage on these unopened nuts.

Slow foraging expansion (Figure 7).

Slow vagrancy affords a species a method of discovering new habitat, which, if environ-

mentally suitable, especially food resources, can result in breeding range expansion. It appears important in this case also as a way of perhaps coping with the changing nature or loss of foods in the northern Jarrah-Marri forest, perhaps through the impacts of climate change and in some cases possibly fire. More likely it could be simply a case of opportunism and the fact that once they discovered the extensive Cape Lilac food resource on the plain, early morning movements to and from the Darling Range to isolated trees became frequent and the birds returned each day until the food source was depleted and again each year at fruiting times to the same trees. Once a feeding site had been located, birds flying in were quickly able to sight other neighbouring trees and thus slowly expand their foraging zone. The birds showed persistence in returning to the same food trees every day until the trees were completely depleted of fruits before moving on.

Judging from our observations of flocks foraging daily in the Jarrah-Marri forest of the Perth Hills region, about 50% of birds from the western edge of the escarpment, i.e. from edge to about 3 km east, are involved in this movement onto the coastal plain, but the bulk of birds from areas further east in the Darling Range remain and forage within the Jarrah-Marri forest. A number of birds banded in the Perth Hills have been recorded moving up to 19 km from their original nest site which confirms their region of origin. For example birds banded as nestlings in Bungendore Park (near Armadale), have been observed at Byford and also at Lynwood and Carlisle.

The daily routine of birds leaving the western edge of the Darling Range at traditional roost sites at or around dawn 06:00–07:00 hrs and flying west, often high up, wheeling around the top of the scarp for a few seconds before flying out over the drop, then descending and levelling out over the tree tops, to suitable feeding sites, often single trees in suburban gardens well out onto the coastal plain. On several occasions small flocks (up to 14) were tracked from a vehicle as they left the edge of the Darling Scarp east of Gosnells at 06:30–07:00 hrs to Welshpool where they began to descend into gardens at Welshpool and Belmont a distance of 16 km. They remained and fed at that site until 16:30–18:30 hrs then flew back towards the Gosnells hills. This behaviour was observed for several weeks in August–September in that area until all green and yellow fruits on the trees were eaten. This daily routine has become commonplace for numbers of birds in the northern forest block and has continued year after year since 2000 and now extending across the entire Perth metropolitan area to forage on fruiting Cape Lilac.

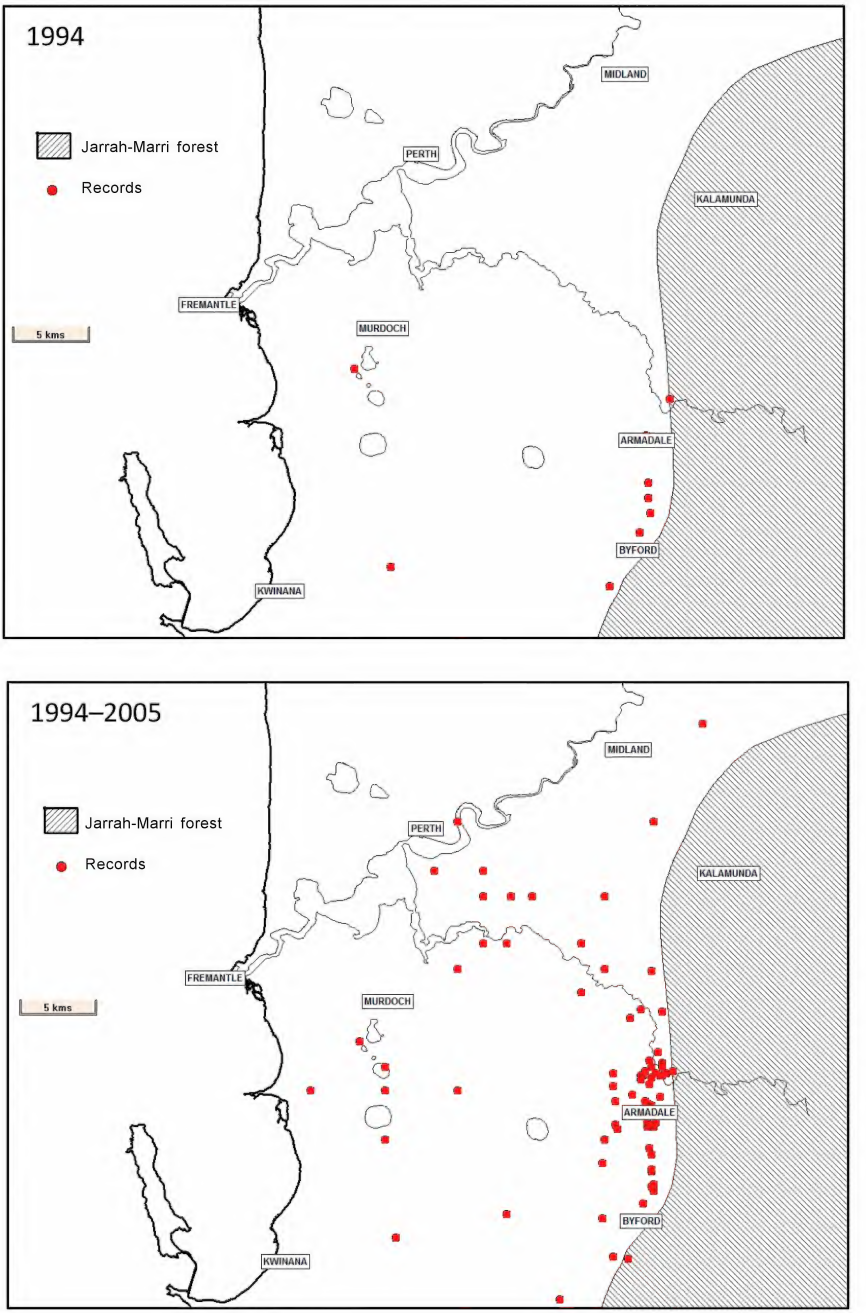

Figure 7. Records indicating slow foraging expansion on to the Swan Coastal Plain in 1994, and from 1994–2005, 1994–2011 and 1994–2016.

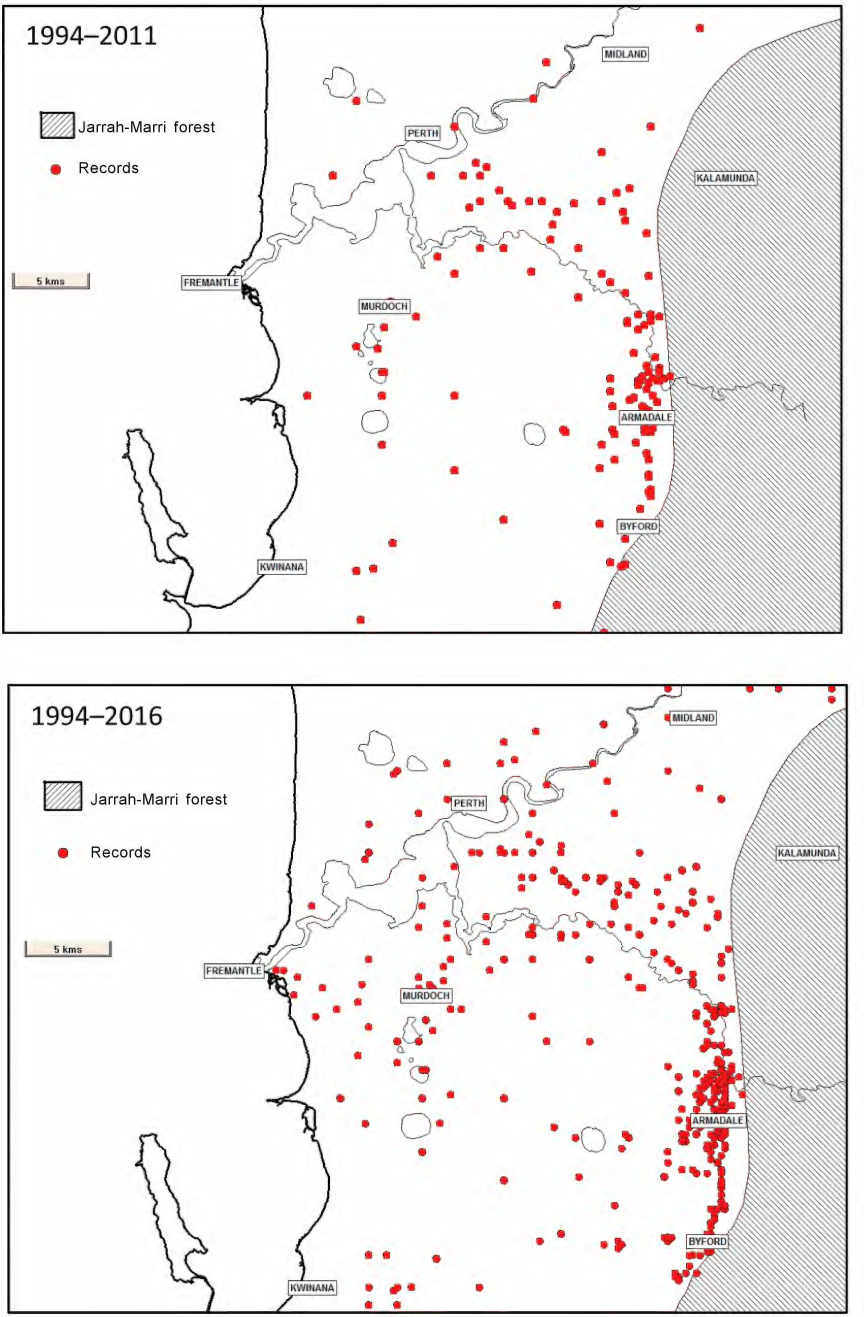

Figure 7 (cont.)

In areas where they found other foods both native and exotic and in some cases suitable roost sites with suitable drinking sites, new roosts were established. In the April 2016 Great Cocky Count for example a total of 771 birds were recorded at 29 roosts on the Swan Coastal Plain. These included counts of 125 at Murdoch, 88 at Byford, 73 at Munster, 57 at Coolbellup, 49 at Floreat, 42 at Kensington, 36 at Morley, 31 at Gosnells, 31 at The Vines, 26 at Darling Downs, 24 at Baldivis and 16 at Parklands. There is considerable variation in numbers at some of these roosts. For example a total of 199 birds was recorded at the Murdoch roost in 2014, 33 in 2015 and 125 in 2016; also 47 at one Yokine roost in 2014, 28 in 2015 and none in 2016. This highlights the fact that there is considerable movement of birds to and from these roosts on the Swan Coastal Plain as well as a movement of flocks each day from the hills region onto the coastal plain.

Following the establishment of roost sites on the coastal plain birds at two sites, Murdoch University and Perry Lakes, began prospecting for breeding hollows and in July 2011 and September 2012 at least two pairs bred successfully in artificial PE tube nest hollows erected at Murdoch (Figure 8). This was extraordinary as a few years previous (2000) there were no birds at all on that part of the Swan Coastal Plain. The fact that these birds bred in an artificial PE tube erected in an exotic pine tree (*naso* favour Marri as nest trees) in a busy university carpark is remarkable and provides some important insights into conservation management.

Numbers fluctuate at these sites no doubt depending on the availability of food so monitoring breeding times and success would provide valuable information on the viability of this population.

At other sites in the south-west, birds were first recorded feeding on Cape Lilac near Boddington in April 2003, at Serpentine and Mundijong in February 2005 and at Dwellingup and Waroona in March 2006 and a small flock was recorded feeding on Cape

Figure 8. Female at a PE Cockatube® mounted in pine tree, Murdoch University.

Lilac at Harvey in May-June 2016. The April 2003 record from near Boddington is of great interest because it was not until March 2006 that birds began to feed on Cape Lilac at a regular Waroona observation site (58 km to west) and it is 80 km to the nearest northern record at Bedfordale. This suggests that there is some movement of birds through the forest.

There is obviously some interaction and movement of small numbers of birds from the Perth Hills to areas further south as some of the flocks in these more southern areas have discovered and learned to feed on Cape Lilac. The recent records of birds feeding on Cape Lilac from Harvey suggest that there has been some interaction of birds along the escarpment between Waroona and Harvey in recent times. We doubt that this discovery and learnt behaviour would have been done independently but more likely introduced to these southern flocks by contact with birds from further north. Probably because of the overall sedentary nature of these populations the expansion or southward-spread into new territory appears to have been very slow and part of this may be due to the destruction and fragmentation of original habitat on the Swan Coastal Plain.

Certainly south of Harvey, birds still have not yet discovered Cape Lilac as a food source despite large numbers of trees growing in towns such as Collie, Brunswick Junction, Boyanup, Bunbury, Whicher Range area, Donnybrook and Capel. Extensive groves of Cape Lilac along laneways in the Tutunup area also have no evidence that birds are currently using this food resource.

Southern Region: Byford-Waroona-Harvey

Between May and November 2015 we carried out a series of mostly east-west transects on the southern Swan Coastal Plain between Byford and Harvey to determine habitat use by Forest Red-tailed Black Cockatoos in roadside verges. These targeted surveys were to search for evidence of feeding, both old and recent, to determine if there was a change in the status of birds during different times of the year. There was a very extensive flowering of Marri (*Corymbia calophylla*) in 2014–15 resulting in a massive nut crop on many trees especially those in road verges in this part of the Swan Coastal Plain. Between May and August 2015 there was very little evidence of recent foraging and indeed few sightings of birds within the region. This was in stark contrast to surveys in September–October 2015 where there was extensive evidence of birds foraging within that region (Figure 9). While there were still some birds observed foraging within the adjacent hills Jarrah-Marri forest there was obviously considerable movement of birds

Figure 9. Surveys showing foraging of Marri seed on the Swan Coastal Plain, May–August 2015 (above) and September–October 2015 (facing page).

from the hills onto the coastal plain to take advantage of the extensive nutting of the Marri in these road verges. As with Cape Lilac further north this appears to be a change in the foraging ecology of some populations.

Unfortunately a great deal of road verge habitat was destroyed around Waroona, Yarloop, Harvey and Lake Clifton in the January 2016 wildfire. With a

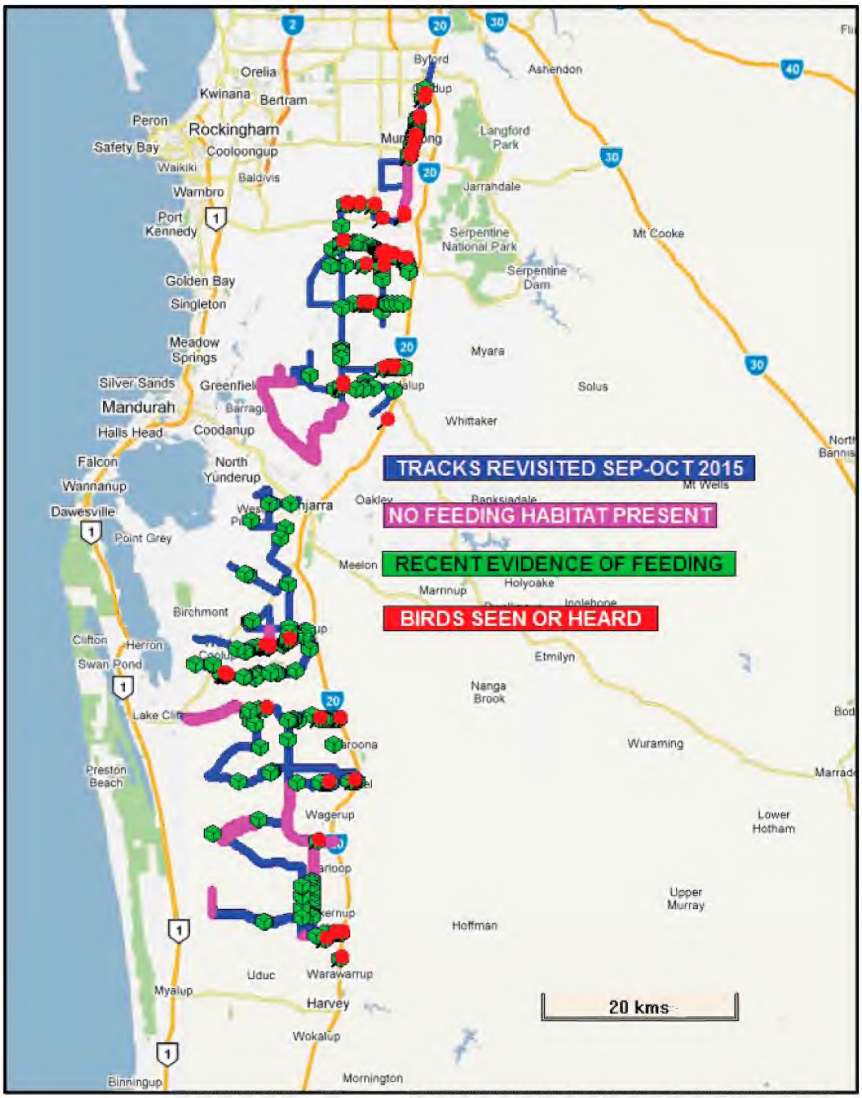

Figure 9 (cont.)

perimeter of 398 km this fire destroyed a total of 69,000 ha.

MORTALITY

Vehicle Strikes

One of the main mortality factors for these birds is vehicle strikes. In August-September 2009 a total of 10 birds including adults and immatures were killed at a drinking site in a truck bay at the edge of Albany Highway in Bedfordale (probably more killed

but not found) and this would have had a significant impact on that small local population.

The movement of birds onto the Swan Coastal Plain, especially around Perth, has greatly increased the risk of birds being killed or injured from vehicle strikes. Records from Kaarakin (Black Cockatoo Conservation Centre) for example show that 11 birds were brought in dead or injured in January 2016; four in February; five in March; seven in April; and eleven in May. Also three birds were recorded as being killed or injured after being hit by a train at Serpentine.

Fire

The loss of nest trees through logging, fire (including prescribed burns) and post-fire clean up, and weather is of concern, especially fire. Fire is acknowledged as a significant factor in the fall of hollow trees (Parnaby *et al.* 2010). Many veteran and stag Marri (the favoured nest tree) are particularly susceptible to fire. Most of these trees have only an outer living shell around rotten heartwood. A fire at the base of these trees quickly burns through the outer shell creating a chimney stack that destroys the tree.

The January 2005 Perth Hills fire for example, destroyed four out of five known nest trees with hollows leaving only a burnt stump or the tree completely burnt to ground.

In May 2011 another three out of five known nest trees in the Wungong catchment were destroyed during a controlled "biodiversity management burn" and it was noteworthy that these trees burnt from the top down indicating a fairly intense fire.

The January 2016 Waroona-Yarloop wildfire had a devastating impact on the flora and fauna of the area. The fire burnt an estimated 69,000 ha including extensive areas of Jarrah-Marri forest and road verges. This fire was extremely intense with the entire canopy, understorey and ground layers being burnt (Figure 10). The loss of about 80–90% of foraging habitat for the small resident flocks in that region means that these birds would have needed to forage well outside their normal home range to survive. The two resources most likely to limit their continual survival in the area are in the short term, the food supply and in the longer term, nest hollows.

Overall this fire was an extremely significant ecological event in that region and we plan to monitor the response of black cockatoos to determine where these populations forage and adapt to change after the burn. Five months after the fire and the widespread presence of basal reshooting and fresh ground growth suggests that some areas of both forest and verge were regenerating rapidly. Nevertheless, there will be a gap in the available food supply chain causing them to forage elsewhere. The loss of many large

Figure 10. Loss of habitat at Lake Clifton January 2016 (top) and Waroona 2016 (bottom) post-wildfire.

veteran Marri that are required for breeding hollows, and which are already scarce in the landscape, is concerning. Moderate fires often help create large hollows suitable for cockatoos in old trees, however, wildfires tend to destroy all old or veteran trees that could provide future hollows.

The same January 2016 Waroona wildfire also swept through the nearby Larego forest block and destroyed a total of 19 of 41 known cockatoo hollows.

Nest Tree loss

During our study we have noticed a fairly high fall rate

(including trees blown over during storms) of veteran and stag Marri (Johnstone *et al.* 2013a) e.g. on 23 November 1999 a nest tree we had been monitoring, in which there was a large chick, blew over in strong easterlies; the chick that was almost ready to fledge was killed (WA Museum specimen A36732).

Feral bees

About 26% of known breeding hollows of Forest Red-tailed Black Cockatoo in our study sites have been taken over by feral European Honey Bees (*Apis mellifera*) and at some sites at the edge of the Darling escarpment (Bedfordale, Serpentine) it is as high as 50%. At one nest hollow in Bedfordale in December 2000, a chick that appeared healthy may have succumbed to swarming bees in the same tree near the hollow entrance.

Ravens

Movement onto the Swan Coastal Plain has also brought these cockatoos into greater contact with Australian Ravens (*Corvus coronoides*) that harass and sometimes kill juveniles and immatures (Figure 11). Attacks and harassment by ravens often leads to the young cockatoos being separated from their adults and being mobbed. Not always do the ravens succeed and, on one occasion, a raven that was attacking and holding tail feathers of a fledgling Red-tailed Black Cockatoo, in a tree, had one of its legs bitten off by an adult male Red-tail Black Cockatoo that was following close behind. Ravens have greatly increased in abundance in the Perth region since the late 1960s and are now common throughout the suburbs and are attracted to road-killed animals, garbage

Figure 11. Red-tailed Black Cockatoo being attacked by an Australian Raven, Bedfordale.

Marri *Corymbia calophylla*

Silver Princess *Eucalyptus caesia*

Illyarrie *Eucalyptus erythrocorys*

Sheoak *Allocasuarina* sp.

Jarrah *Eucalyptus marginata*

Cape Lilac *Melia azedarach*

Figure 12. Some common foods (native and introduced) on the Swan Coastal Plain.

dumps and spilt food in parks and around food take-away outlets.

DIET

Principal native food species

The principal foods (Figure 12) of the Forest Red-tailed Black Cockatoo in the northern Jarrah-Marri forest and the Perth Region are the seeds of Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) and their method of feeding on these fruits is distinctive (see Johnstone and Kirkby 1999). Other less important foods include Blackbutt (*Eucalyptus patens*), Sheoak (*Allocasuarina fraseriana*), Snottygobble (*Persoonia longifolia*), *Hakea* spp. including *H. petiolaris*, Tuart (*Eucalyptus gomphocephala*) and Red Heart or Moit (*E. decipiens*).

Introduced food species

Some introduced species regularly foraged include the Cape Lilac (*Melia azedarach*); Spotted Gum (*Corymbia maculata*) a native of eastern Australia (Queensland, NSW and Victoria) and commonly grown in the Perth region; Lemon-scented Gum (*C. citriodora*) originally from Queensland, but naturalised in the Darling Range and in suburban Perth; Silver Princess (*Eucalyptus caesia*) endemic to the central wheatbelt region of Western Australia, but common in Perth gardens; Illyarrie (*Eucalyptus erythrocorys*) endemic to the limestone ridges of the Dongara region of Western Australia and commonly grown in Perth gardens; Bushy Yate (*Eucalyptus lehmannii*) endemic to the south-west of Western Australia (mainly Albany and Esperance Plain) and used as a street tree in Perth and Kaffir Plum (*Harpephyllum caffrum*) a native of southern Africa and grown in Perth gardens and used as a street tree. Also of interest recently was a flock of 12 birds feeding on olives *Olea europaea* in Shenton Park.

IMPLICATIONS FOR THE FUTURE

The past half century has seen massive environmental change in the south-west of Western Australia. The region is now a severely fragmented landscape and the future loss of habitat, the changing structure of the Jarrah-Marri forest through forestry and fire, the impact of introduced and invasive species and the effects of climate change make the survival of the Forest Red-tailed Black Cockatoo and indeed its forest relative Baudin's Cockatoo (*Calyptorhynchus baudinii*) of great concern. As Jarrah and Marri availability becomes increasingly threatened in the face of habitat modification, climate change and fire, Forest Red-tailed Black Cockatoos may become more dependent on some introduced species for food in some areas. The change in foraging behaviour by Forest Red-tailed

Black Cockatoos suggests opportunism, but could also be possibly linked or have been evoked by a decline in the availability or nature of Jarrah and Marri as food in some parts of the Darling Range due to declining rainfall. The big downside of this movement of birds onto the Swan Coastal Plain has been the additional impact of mortality with many deaths from collisions with motor vehicles and this loss is not sustainable. Furthermore the altered foraging behaviour has led to local changes in distribution and roosting patterns that will no doubt also influence breeding success. While Forest Red-tailed Black Cockatoos feed their fledglings on Cape Lilac seed, it may not be a suitable food to stimulate and sustain the next breeding cycle. Further studies are required on the availability of different food resources in different years which may help determine what triggers important breeding events.

In 2016, almost no Forest Red-tailed Black Cockatoos were recorded breeding at any of our study sites and no juveniles (birds of the year) were recorded in the northern Jarrah forest or on the Swan Coastal Plain. This indicates that this population may be at greater risk that we originally thought.

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NOTES ON THE RELATIVE ABUNDANCE OF THE PERTH LINED SKINK, *LERISTA LINEATA* ON GARDEN AND ROTTNEST ISLANDS: A HAND-SEARCHING EXAMPLE

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ABSTRACT

The fossorial skink *Lerista lineata* has a very fragmented distribution on the Swan Coastal Plain having suffered considerable habitat loss. It also occurs on Garden and Rottnest Islands, where recent biological surveys appear to demonstrate contrasting differences in relative abundance which may be attributed to the degree of habitat disturbance between the two islands. To test this theory we conducted a standard number of two hour hand-searches at eight selected sites throughout each island. We recorded a total of 16 individuals at seven sites on Garden Island but only three at two very adjacent sites on Rottnest Island. We propose that this provides insight that even insular populations of small reptiles can be severely impacted by long-term habitat disturbance and highlight the lack of information available on the herpetofaunal assemblages inhabiting the threatened Swan Coastal Plain ecosystems.

INTRODUCTION

The Swan Coastal Plain has the highest human population in Western Australia, and it is predicted that by 2050, 3.5 million people will live in the metropolitan area. This is an increase of almost 70% on the 2015 population (Ramalho *et al.* 2014; Government of Western Australia 2015). As a result, the long-term survival of several reptile species that have restricted distributions on the Swan Coastal Plain may be significantly impacted. This requires urgent attention to determine their current conservation status. Maryan *et al.* (2015) provided an overview of the status of one of these species, the Perth Lined Skink, *Lerista lineata* and made comments on distribution including occurrence on Garden and Rottnest Islands.

It is generally considered that island populations are under far less threat from anthropogenic disturbances than their mainland counterparts (Ford 1963;

Burbidge and McKenzie 1978; How *et al.* 2009; Doughty *et al.* 2012). These island populations become very significant conservation entities for future management. The obvious examples on Garden Island are the Tammar Wallaby *Macropus eugenii* and Carpet Python *Morelia spilota imbricata*, and on Rottnest Island the Quokka *Setonix brachyurus*. Both of these mammals have disappeared on the adjacent mainland and populations of the python have been severely fragmented. When the historical documentation and relatively recent surveys of *L. lineata* are compared between the two islands there appears to be contrasting differences in relative abundance. Garden Island (1200 ha) has a relatively continuous, undisturbed environment protected by an Australian Naval Base which occupies about one third of the island which restricts public access to the remainder. Rottnest Island (1900 ha) on the other hand is an iconic tourist destination and has a long history of anthropogenic disturbance, including farming and the introduction of exotic predators and competitors (Bush *et al.* 2010). The vegetation of Garden and Rottnest Island is similar (Marchant and Abbott 1981), with the majority of their native plant species common to both islands. However, unlike Garden Island which has suffered fewer disturbances, over the past 200 years, the vegetation of Rottnest Island has been heavily exploited by humans to the point where the concept of 'natural' vegetation is almost irrelevant (Rippey and Hobbs 2003).

On Garden Island, the most recent biological survey using pit-traps was by Brooker *et al.* (1995a). This survey recorded *L. lineata* on nine of 20 sampling sites, of which ten of the 13 individuals trapped were on sites with *Melaleuca lanceolata* Low Forest or *M. huegelii* Scrub. Of particular note is only one individual was found on sites without trees. By contrast, on Rottnest Island a series of surveys conducted between 2002–07 did not record *L. lineata* (J. Dell, unpublished). Prior to these surveys on Rottnest Island, the only recorded instance of trapped *L. lineata* was made by Burke (1986) at the former Army Reserve located at the eastern end of the island. This area was chosen as a suitable site by Burke due to the land having remained relatively undisturbed, whilst providing a range of vegetation communities. Based on this information, Maryan *et al.* (2015) suggested the relative abundances of the insular populations of *L. lineata* required investigation with particular attention to Rottnest Island, where *L. lineata* had remained unrecorded for almost three decades.

Biological surveys that combine trapping with hand-searching by experienced field naturalists are important in determining population comparisons of species and play a crucial role in increasing

knowledge of local distribution, relative abundance and habitat preferences (Maryan and Turpin 2012). This is particularly relevant for some fossorial reptile groups such as *Lerista*, which for several species, and for reasons unknown appear to have a combination of low vagility and high site fidelity. It is possible to reveal reasonable numbers of them by hand-searching when conditions are optimal (B. Maryan and G. Gaikhorst, unpublished). An example of the benefits of hand-searching by experienced field naturalists is that during the course of the major regional Carnarvon Basin Survey, the capture numbers by hand were greater than the numbers recorded from the combined PVC tube and bucket capture methods for the majority of the recorded *Lerista* species (Rolfe and McKenzie 2000).

RESULTS AND DISCUSSION

During July 2016 (Garden) and 2015 (Rottnest), we conducted standard 2hr hand-searches for *L. lineata* over two days at eight selected sites by raking (using 3-pronged cultivators) the upper layers of loose soil beneath leaf litter, logs and other debris. This is an effective survey method to reveal the presence of *Lerista* species with minimal disturbance to the habitat.

On Garden Island our searches revealed a total of 16 *L. lineata* individuals from seven sites in habitats with a combination of *Melaleuca* Forest and *Acacia rostellifera* Scrub with ample leaf litter, logs and surface debris. By contrast, on Rottnest Island the same survey effort revealed only 3 individuals at two very adjacent sites on secondary dunes with predominately dense *Acacia rostellifera* Scrub (Table 1). We consider our hand-searching efforts on Garden Island to be a productive outcome when compared to the 13 individuals trapped on nine of 20 sampling sites over two five-day trapping periods in April and November 1991 by Brooker *et al.* (1995a). It was also rewarding to record *L. lineata* on Rottnest Island after almost three decades of not being seen from or near to the Burke (1986) survey locality.

These results show that a combination of trapping and hand-searching methods have recorded *L. lineata* from multiple locations throughout Garden Island but only from a single area at the eastern end of Rottnest Island. In light of this, it is interesting to briefly discuss the history of habitat disturbance and related introduction of exotic predators and competitors on the two islands.

Garden Island has experienced only intermittent settlement since the early 19th century and since 1915 has been under the control of the Commonwealth of Australia (Brooker *et al.* 1995a). As a result, it has remained virtually free of major anthropogenic disturbance and mammal introductions. The original

Table 1. Hand-searching results at eight sites each for *L. lineata* on Garden and Rottnest Islands.

#	Location	Latitude/Longitude	Brief Habitat Description
	Garden Island		
1	Site 1, Firebreak	32°10'16"S 115°39'55"E	*Melaleuca* Forest and *Acacia*
4	Site 2, Herring Bay	32°09'47"S 115°39'46"E	Mixed *Melaleuca* and *Acacia* with dunes
1	Site 3, Northern End	32°09'28"S 115°39'56"E	As above
1	Site 4, Cliff Head	32°11'14"S 115°40'30"E	*Melaleuca* Forest and *Acacia* behind beach
0	Site 5, Southern End	32°14'41"S 115°41'16"E	Low Scrub, sword-sedge and limestone
1	Site 6, Broun Bay	32°14'39"S 115°41'24"E	As above with large *Acacia* patches
4	Site 7, Quarry	32°14'27"S 115°40'58"E	*Melaleuca* Forest and *Acacia*
4	Site 8, Sewage Plant	32°12'44"S 115°40'45"E	As above
	Rottnest Island		
0	Site 1, Research Station	32°00'26"S 115°32'51"E	*Melaleuca* Forest, sparse *Acacia* and limestone
2	Site 2, Bickley Bay	32°00'24"S 115°33'15"E	Dense *Acacia* on dunes
0	Site 3, Mary Cove	32°00'59"S 115°29'35"E	Isolated *Acacia* on low rise and limestone
0	Site 4, Porpoise Bay	32°01'14"S 115°31'34"E	Isolated *Acacia* on dunes
0	Site 5, Parakeet Bay	31°59'15"S 115°30'51"E	Low Scrub, sword-sedge and limestone
0	Site 6, Salmon Bay	32°01'06"S 115°31'23"E	Isolated *Acacia* on dunes
0	Site 7, Stark Bay	32°00'20"S 115°29'16"E	As above beside road
1	Site 8, Bickley Point	32°00'36"S 115°33'03"E	Dense *Acacia* on dunes

vegetation of the island has remained in good condition consisting of Low Forests and Scrub of *Melaleuca lanceolata, M. huegelii, Callitris preissii* and *Acacia rostellifera* in various combinations, which covers over 70% of the island. Historical reports of mammal introductions are few consisting of sheep and rabbits (Brooker *et al.* 1995b), and birds, of a small feral population of Common Turkey (Storr and Johnstone 1988). Feral cats were established on the island up until the 1970s, however only a single sighting was made by Brooker *et al.* (1995b). Foxes and cats occasionally access the island via the causeway but intensive

eradication programs prevent their establishment on the island. Both Garden and Rottnest Islands have had introductions of the commensal Black Rat and House Mouse at various times, with the latter currently established on both islands.

Although on Rottnest Island the original vegetation prior to settlement was similar to Garden Island, the Forests and Scrub now covers less than 10% of the island as scattered relict stands. The vegetation cover of the island is now dominated by a grassy Scrub in which the shrub *Acanthocarpus preissii* and the grass *Stipa variabilis* are the dominants (Beard 1990). On the mainland Coastal Plain our observations of habitat preferences for *L. lineata* typically are a combination of trees, *Banksia* and/or *Eucalyptus* supporting heathlands and shrublands, providing a well-developed patchy leaf litter ground cover. In light of this, the dominance of the grassy Scrub which now covers two-thirds of the island could be considered unsuitable as it provides poor-quality microhabitat (B. Maryan and G. Gaikhorst, unpublished).

The above comments on habitat preferences are supported by How *et al.* (1996) who found that *L. lineata* with 89 individuals captured was the second most abundant skink species sampled during a pit-trap survey at Woodman Point on the mainland opposite Garden Island. The three sites at Woodman Point had a woodland canopy of *Acacia rostellifera*, *Callitris preissii* and *Eucalyptus gomphocephala* with virtually no understorey species and structurally were very similar to the sites where *L. lineata* was captured by us on Garden Island.

Introductions of mammals to Rottnest Island following the commencement of farming in the early 19th century were pigs, horses, rabbits, sheep and cattle. The introductions of exotic predators that may have impacted *L. lineata* are the cats and birds. The island population of *Egernia napoleonis* is now possibly locally extinct on the main island, with the last confirmed observation of one killed by a cat in 1959. Today, only a small population occurs on one islet off the island coast (Bush *et al.* 2010; B. Maryan and G. Gaikhorst, unpublished). This is not without precedent in Western Australia, as shown by the disappearance of *E. stokesii* on Rat Island in the Houtman Abrolhos between 1889 and 1913, following the introduction of cats (Storr 1983). Feral cats have been successfully eradicated from Rottnest Island since 2002 (Algar *et al.* 2011). The Indian Peafowl and Common or Ring-necked Pheasant were introduced to the island during the early 20th century by the Perth Zoo, with the latter common in most habitats, but favouring well-wooded country (Storr and Johnstone 1988). Invasive birds throughout the world are documented to have caused negative

environmental impacts (Martin-Albarracin *et al.* 2015) with peafowl and pheasants known to include small reptiles in their omnivorous diet. Their current status is that four male peafowl (females have been removed to prevent breeding) and some pheasants are still present on the island, though the latter are not recorded in large numbers (C. Thomas, pers. comm.).

The available evidence suggests there are differences in relative abundance for *L. lineata* on Garden and Rottnest Islands that maybe attributed to the contrasting level of disturbance and possibly the historical introductions of exotic predators and competitors. As it is difficult to distinguish between complete absence and very low density', for those species that are very cryptic, it often requires a considerable length of time to reveal their presence, and this is only achieved by conducting trapping programs (How and Shine 1999). However, the most recent trapping effort on Rottnest Island conducted intermittently over a five year period did not record *L. lineata* (J. Dell, unpublished). Prior to this *L. lineata* was recorded during the 1980s by Burke (1986) in reasonable numbers at the eastern end of the island, the same area where we found only three individuals. This possibly suggests the Rottnest Island population of *L. lineata* has been negatively impacted by long-term habitat disturbance. To our knowledge this provides the first insight in Western Australia that even a small fossorial reptile on an island can be adversely affected. We suggest that further long-term monitoring is required on Rottnest Island using traps complemented with hand-searching, to more accurately determine the local distribution, relative abundance and habitat preference of this species. If further surveys reveal that *L. lineata* is locally-restricted to what are already fragmented relict habitats, and considering the substantial and continual habitat loss on the mainland, any future developments planned on Rottnest Island should consider the requirements of this conservation significant species.

Finally, we consider that it is a misconception to think that our knowledge and understanding of the Swan Coastal Plain herpetofauna is complete. The recording of interesting reptile distributional records on the Swan Coastal Plain in recent times highlights the paucity of fauna surveys in the region (Turpin 1990; Maryan and Browne-Cooper 1995; Algaba 2005; Davis and Bamford 2005; Davis and Wilcox 2008; Maryan and Algaba 2011). Today, the southerly extent of the known distribution of *L. lineata* remains uncertain (Maryan *et al.* 2015). It also underlines that there are significant gaps in even the most basic information on the distribution of herpetofauna inhabiting southwestern Western Australia, ironically the most

intensely developed part of this state while being recognised globally as one of the world's top 25 biodiversity hotspots (Myers *et al.* 2000). The recent discovery of undescribed reptiles (e.g. Kay and Keogh 2012; Doughty and Oliver 2013) shows that we are still far from completing the inventory of the vertebrates inhabiting the highly fragmented natural habitats of southwestern Western Australia.

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A FURTHER RECORD AND OBSERVATIONS ON THE FLOWERPOT SNAKE *INDOTYPHLOPS BRAMINUS* IN SUBURBAN PERTH

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ABSTRACT

The Flowerpot or Brahminy Blindsnake *Indotyphlops braminus* is the only recorded parthenogenetic snake. While originally from South-East Asia, it now has a broad distribution due to dispersal by humans. This dispersal has been aided by the species' reproductive biology, since a single female can establish a new population, and by its frequent use of soil in containers (hence one of its common names). The Flowerpot Snake has been recorded at scattered locations across mainland Australia, with two records from northern Western Australia (Port Hedland in 1997 and Karratha in 2006), and one record from the south-eastern suburbs of Perth (2004). This paper reports on multiple records of the species from one garden in Perth's northern suburbs over the period 2014 to 2016. It is believed the animals colonised from a pot importing business located only 200m from the garden. The number of records and the presence of hatchlings suggest that the population is well-established. Furthermore, as this is a cryptic species that can be readily overlooked or misidentified as a worm, it is likely that the population is widespread at least in the immediate vicinity of the garden.

INTRODUCTION

Indotyphlops braminus, the Flowerpot Snake or Brahminy Blindsnake, is a small (typically 120–130mm but reaching a maximum of 230mm total length) subterranean blindsnake (Typhlopidae) (Page *et al.* 2008). Australia has an estimated forty-three species of typhlopids (all native species are in the genus *Anilios*), with *I. braminus* the only introduced and the smallest (MacDonald 2016). *I. braminus* has glossy black, purplish or greyish body; often the snout and venter are slightly paler. Like other typhlopids, *I. braminus* is adapted

Figure 1. A specimen of *Indotyphlops braminus*, collected in the Kingsley garden, 11/06/2016. Photograph by Kit Prendergast.

to a burrowing lifestyle with a blunt head, nares protected in a nasal cleft, vestigial eyes covered by a thick, transparent ocular scale; and a rigid, cylindrical body covered with small, uniform, tightly-overlapping scales (Ehmann and Bamford 1993). As with other typhlopids, *I. braminus* has a relatively short tail (1.5–5% total body length) terminating in an obtuse, conical spine capping the terminal caudal vertebra (Ehmann and Bamford 1993), a ventrally-located mouth that contains only three short, recurved teeth on the maxilla of the upper jaw, and no dentition on the lower jaw (Ehmann and Bamford 1993). Having a jaw with minimal dentition and mobility, the limited gape of blindsnakes restricts them to small-sized prey items, in contrast with most snakes. In common with other blindsnakes the diet of *I. braminus* mainly consists of ants and termites and their larvae and pupae, but there have been records of this species also consuming beetle larvae, small flies, fungi and even insect excrement (Page *et al.* 2008).

Typhlopids, including *I. braminus*, are fossorial and rarely come to the surface. Exceptions occur after heavy rains when soils become waterlogged, especially on warm, humid nights following rain (Ehmann and Bamford

1993). *I. braminus* inhabits a range of terrestrial environments including agricultural and urban areas, and is often found in urban/suburban garden beds and pot plants (Page *et al.* 2008). Their preferred substrate is that of loose soil (humus, loam and sand) with adequate moisture (Page *et al.* 2008). They can also be found under decaying organic debris like logs and leaf litter (Page *et al.* 2008).

I. braminus holds the record for having the widest distribution of any snake on the globe, but this is an artefact of human intervention (Durso 2014). *I. braminus* was described in 1803 from South-East Asia, and it is believed the species originated in this region. It now occurs on almost every continent, including parts of not only Eurasia but America, Oceania and Australia, especially in the tropic and subtropical regions, and additionally has been introduced to many islands (Durso 2014). Its geographic range outside Australia is estimated to be 11.23 million km^2 (Page *et al.* 2008). *I. braminus* is only a recent arrival to Australia, first recorded in Darwin in 1968 (Storr 1968). It has since spread to scattered locations across mainland Australia but is absent from offshore islands, including Tasmania, and from arid regions (Page *et al.* 2008).

This species of snake has clearly undertaken some fantastic voyages across the globe. An unusual 'fantastic voyage' undertaken by one specimen was reported by O'Shea *et al.* (2013). In Timor-Leste, a blindsnake was recorded emerging from the cloaca of a toad (*Duttaphrynus melanostictus*) – still alive! After finally being expelled from the toad's cloaca, the blindsnake survived for over 7.5hrs until it finally succumbed to death, likely due to anoxia, constriction by the toad's cloacal sphincter, and/or the chemicals experienced during its passage through the toad's gastrointestinal system.

The rapid spread of the species can be attributed to its unusual behaviour and biology; and the behaviour of its dispersal agent. As denoted by one of its common names, the Flowerpot Snake has a penchant for inhabiting the potting mix within pot plants. It is believed that via this mode of transport, it stowed away in pot plants and humans have inadvertently transported this small, unassuming species across the globe (Durso 2014).

A species' ability to colonise new areas depends not only on its ability to be dispersed to a new area, but also on its ability to reproduce and establish a population there. In this respect, *I. braminus* is unparalleled among snakes for it is the only snake in the world that is obligatorily parthenogenic (Durso 2015, Ota *et al.* 1991). A single (and therefore female) *I. braminus* can thus found a new colony and populate a new environment. This all-female species is triploid, with 14 triplets of chromosomes,

giving a karyotype with a total of 42 chromosomes (Durso 2015, Ota *et al.* 1991). It is believed this species originated via a hybridisation event between two (unknown) normal diploid sexually-reproducing blindsnake species, presumably somewhere in south-east Asia (Durso 2015). The 'age' of the species is not known.

I. braminus is oviparous and produces clutches comprising one to eight thin-shelled eggs (average 3.7) (Page *et al.* 2008, Ota *et al.* 1991). Larger females produce larger clutch sizes (Kamosawa and Ota 1996, Ota *et al.* 1991). These unfertilised yet viable eggs produce offspring that are virtually genetically identical to each other and the mother.

Only limited observations of *I. braminus* occurring in Western Australia (WA) have been reported (Gaikhorst 2005, Page *et al.* 2008). Ten observations have been logged in the WA Museum database, with the first record at Port Hedland (1997; K. Coate), and the latest of a specimen in a pot plant in Karratha (2006; P. Kendrick). Both these towns are in the north of the state. Only one observation of *I. braminus* has been in the southwest of WA; (2004 G. Brown observed a specimen on the carpet in his bedroom in Kewdale, a south-eastern suburb of Perth). Below, we report and describe observations of *I. braminus* involving multiple occurrences at one site in suburban Perth, Western Australia.

BACKGROUND TO SITE

The site where observations were made is in the suburb of Kingsley at 31° 48' 12"S, 115° 49' 03"E in the northern suburbs of Perth. It is a suburban garden established from 1989, at a location where native vegetation was cleared for agriculture in the early 1920s. The block is large for the area, 2,100m^2, part of which is taken up by a house, sheds, driveway and carport. The garden thus has an area of about 1,500m^2 and has progressively been developed with native vegetation. However, it includes lawn, paths, a small orchard and a poultry run. Surrounding properties are similar in size but are more developed, with large houses, extensive paving and lawns, swimming pools and manicured exotic plantings.

The native reptile assemblage of the garden has been documented (Bamford and Calver 2012) and has developed with maturation of the garden. Resident species include a gecko and seven skinks. One of these, *Ctenotus fallens*, was exterminated by a single domestic cat but has been the subject of a so-far successful reintroduction program (unpubl.). Observations on the reptiles and other fauna of the garden are made regularly by the residents.

OBSERVATIONS

The first record of *I. braminus* in the Kingsley garden was made on

Table 1. Observations of *I. braminus* in the Kingsley garden.

Date	Observation
15/08/2013	Adult found under a rotten log in the back garden
17/12/2013	Adult dug up while planting a fruit tree in the poultry run
21/06/2014	Hatchling under bowl in shade house
3/05/2015	Hatchling active at night on the surface in back garden; bare sandy ground
15/11/2015	Immature (<1 year old) found dead on surface in back garden
16/12/2015	Adult active at night on brick paving in the front garden
18/02/2016	Adult under pot in back garden
6/03/2016	Adult dug up on edge of poultry run
10/03/2016	Two hatchlings found on floor in back room
20/05/2016	Adult under a rock in the front garden
11/06/2016	Hatchling found on surface in back lawn in daylight

15 August 2013 (Table 1). Subsequently the species has been observed regularly with five sightings in the first six months of 2016. Most individuals have been uncovered when gardening and have either been under a rock or log, or have been exposed when digging at a depth of about 20cm. Several, however, have been found active on the surface; one at night and one moving through the lawn in daylight. There has also been one found dead on the surface, possibly inadvertently stepped on and found later. Two, both hatchlings, have been found in the house. These were possibly siblings perhaps from eggs laid very close to the back door. The species has been found in both the back and front gardens.

DISCUSSION

I. braminus may have been established in the Kingsley garden for several years before it was discovered, as it is small and cryptic, and that it was recognised at all and not mistaken for an earthworm is probably due to the residents being zoologists with a keen interest in reptiles. The multiple observations and presence of hatchlings as early as June 2014 indicates that a breeding population has become established, and is very likely established in neighbouring gardens. The record of hatchlings from autumn to early winter suggests that the species is breeding across summer with hatching in late summer/early autumn, in common with most native reptiles of the Perth region (Davidge 1980).

The origin of this population is uncertain, but until 2014 there was a plant nursery and pot importing business on a main road about 200m from the garden. The pots came from South-East Asia and this is very likely the source of the founding animal or animals. To reach the garden, the snakes would have had to have crossed a major road (dual carriageway).

The implications of this introduced species are uncertain. It is a declared pest by the Department of Food and Agriculture WA (DAFWA), and modelling by the department based on climate and the world distribution of the species predicted that the southwest of WA would not support it (Page *et al.* 2008). This is clearly not the case and while the Kingsley garden population is not in a strictly natural environment, the animals are exposed to the natural temperature range of the area, while the garden has limited reticulation so they are also exposed to the long dry summer typical of the region's Mediterranean climate.

The listing by DAFWA is precautionary and there is no evidence that *I. braminus*, as an introduced, non-native species, has any potential detrimental effects on native fauna, or detrimental ecological or economic impacts. Coincidentally, the garden supported a flourishing population of the introduced Argentine Ant (*Linepithema humile* (formerly *Iridomyrmex humilis*)) and this has declined dramatically since 2014. The possibility of an interaction between *I. braminus*, a predator of ant larvae and pupae, and the Argentine Ant, would be worth investigation. If there is such an interaction, there may also be interaction between *I. braminus* and native ant species.

Now apparently well-established in the Kingsley garden, it is likely that there are other populations in the Perth region and that the species will spread throughout the metropolitan area. Its potential to move into natural environments is unknown but it has done so elsewhere in its introduced range.

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STATUS OF *SENECIO CONDYLUS* (ASTERACEAE) IN WESTERN AUSTRALIA

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ABSTRACT

Senecio condylus a recent segregate from the *Senecio lautus*/*S. pinnatifolius* complex is confined largely to manmade or highly disturbed habitats of the Swan Coastal Plain around Perth, unlike its relative *S. pinnatifolius* which is confined to natural habitats. Coupled with its recent recording we suggest that the species is not a native component of the genus *Senecio* but is rather an introduced taxon either from Europe or southern Africa.

INTRODUCTION

Senecio is a very large almost cosmopolitan genus of over 1300 species, with the greatest diversity in South America and Africa. Although many segregates of the genus have been made the genus remains in need of a worldwide revision. Fortunately in Australia the genus has recently been subject to a detailed taxonomic review culminating in a Flora of Australia treatment (Thompson, 2015). Currently 87 species (10 naturalised) have been recorded in Australia. In Western Australia 34 species are known (27 native and 7 naturalised).

Thompson (2005a) reviewed *Senecio glossanthus* and described a new species, *Senecio condylus* I. Thomps. While previously considered part of the *Senecio lautus* complex Thompson (2005a) considered it more closely related to *Senecio glossanthus*. In a subsequent paper, Thompson (2005b) placed all Australian collections previously called *S. lautus* into the endemic Australian species *S. pinnatifolius*. He restricted *Senecio lautus* to New Zealand, following the recommendation of Belcher (1963) and now supported by phylogenetic studies (Roda *et al.* 2013). Thompson (2005b) re-described the variation in *S. pinnatifolius* into a complex of 10 closely related species and designated the variation of the Australia wide *S. pinnatifolius* under 8 subspecies.

Despite its abundance there are very few photographs of the

characteristics or habitats of *Senecio condylus*, therefore, a series are presented in this paper. *Senecio condylus* differs from *Senecio glossanthus* in having the outer floral bracts with intense purple pigmentation in upper third (Figure 1), from the *Senecio pinnatifolius* complex in having markedly dimorphic achenes (achenes of female florets (those marginal flowers with the long yellow rays attached) about 1 mm longer than those of the bisexual florets (Figure 2), and leaves with the lower surface with persistent coarse hairs (Thompson 2005a,b). The species is confined to the

Figure 1. *Senecio condylus* showing purple pigmentation of floral bracts.

Figure 2. *Senecio condylus* showing heteromorphic achenes, larger pale fruits at base with darker smaller central fruits.

southern Swan Coastal Plain between Perth and Busselton, normally on deep sands.

All previous records of *Senecio condylus* in Western Australia were treated as *Senecio lautus* subsp. *maritimus* or *Senecio lautus* subsp. *dissectifolius* (Green 1985). Lander (1987) in *Flora of the Perth Region* noted that "Material from the Perth region comprises two easily recognisable variants: subsp. *dissectifolius* has mostly finely dissected or lobed, narrow leaves and subsp. *maritimus* has undivided or rarely coarsely lobed dentate broad leaves." That this was the case is demonstrated by the collection of *Senecio condylus* previously determined as *S. lautus* subsp. *maritimus* along the Perth to Mandurah highway at Waikiki by Nicholas Lander in 1983. The leaf character is still the simplest way to separate the two taxa in the field (Figure 3).

Figure 3. Undivided dentate broad leaves of *Senecio condylus*.

HISTORICAL INFORMATION

Historical and recent collections of *Senecio* species are held in various Australian Herbaria, these are listed under their acronyms (Western Australia: PERTH, Sydney: NSW and Melbourne: MEL).

Coastal populations of *Senecio lautus* subsp. *dissectifolius* in the Perth area became *Senecio pinnatifolius* var. *latilobus* (Thompson 2005b). Thompson (2005b) restricted *Senecio lautus* subsp. *maritimus* (as *Senecio pinnatifolius* var. *maritimus)* to eastern Australia and the southern coast of Western Australia to Cape Naturaliste with an outlying population on Rottnest Island. The Rottnest collection (Green 521, Dyers Island off Rottnest PERTH) on which this record is based is a very poor match to this subspecies and appears to fit the island ecotype of *Senecio pinnatifolius* var. *latilobus,* which occurs on guano rich soils from Rottnest to the Abrolhos Islands. Thompson (2015) named the other material placed under *Senecio lautus* subsp. *maritimus* at PERTH as *Senecio condylus.*

The earliest herbarium record of *Senecio condylus* is a collection of J.C. Wiburd, s.n. from the Cape Naturaliste area in September 1904 in NSW Herbarium. The second record was from Coode Island in Victoria in October 1908 (Tovey, JR s.n., 10/1908 in MEL and Melbourne University Herbarium). These were noted as naturalised and identified as a European *Senecio (S. nedrodensis* var *glabrata)* and were collected as part of a study on naturalised plants for Victoria (Ewart and Tovey 1909).

Max Koch also collected the species from Busselton in October 1909 (M. Koch, 1978, PERTH). None of these populations appear to have persisted as the species is only beginning to be collected around Bunbury/ Busselton at present.

The first herbarium records for the Perth area are several collections from the Fremantle area {?Medina} in July, September and October 1947 (e.g.: Ingleton s.n., October-1947 PERTH) made by the Dairy Section of the Western Australian Agriculture Department suggesting it was present in areas used as fodder for dairy cows. There were suggestions that these plants were partially toxic, a claim made by Bennetts (1935) in his Presidential address to the Royal Society of Western Australia, but later considered erroneous by Bennetts and Gardner (1956). This suggestion of the plant's potential weedy and toxic nature is supported by material submitted for identification from "JB" of Group Settlement 39 via Mundijong to the "Western Mail" (Western Mail, Plants for Identification, 25-September-1924, page 4) as "growing very thickly on his paddocks" and identified by Government Botanist C.A. Gardner as *Senecio lautus.* This seems by the locality very likely to be *S. condylus.* The next record

Figure 4. Typical habitat of *Senecio condylus* in Perth area (Old Collier pine plantation).

Figure 5. *Senecio condylus* has invaded disturbed dunes in Mangroves in Bunbury in past decade.

was a collection from South Perth in 1953 (Royce 4319, PERTH). Collections were also made along Stock Road, Spearwood by 1980, in the camping ground in Leschenault Conservation Park in 2001 and Busselton in 2006. The vast majority of populations occurring on highly disturbed sites, both in the past and at present.

Senecio condylus is currently the most visible and abundant *Senecio* species in the Perth area with very large populations on disturbed dunes at City Beach, Floreat Park, Cottesloe, along the Freeway margins, and most coastal roads in the Perth-Fremantle area, and under pine plantations in South Perth (Figure 4).

The earliest record from a bushland area was not until 1992 from the Port Kennedy Bushland (BJ Keighery & N. Gibson 858, PERTH), then Lake Richmond in 2000, where it was recorded as a weed. Records have now appeared from Pagononi Bushland (2000), Lake Cooloongup (2005), Piney Lakes (2008), Anstey Keene Damplands (2013) and Kensington Bushland (2016). As Perth has expanded north *Senecio condylus* has also, being found around car parks, road-verges and disturbed dunes up to Ocean Reef, where it was not previously known. In the Bunbury area *Senecio condylus* has begun to invade coastal bushland sites such as the Preston to Ocean Regional Park and sand rises in the Mangroves around the Leschenault Inlet (Figure 5). All of these records are after fire or alongside tracks or other disturbed areas.

Completely different to this species are the records for *Senecio lautus*, (now *Senecio pinnatifolius* var. *latilobus*) which was collected by Preiss (Preiss 114) at Fremantle on 15-12-1838, Rottnest (Preiss 109) on 20-8-1839 and Perth (Preiss 110) on 16-7-1839. Oldfield collected this taxon at Fremantle in 1859 (MEL), Price at Murray in 1872 (MEL); Sewell along the Swan in 1883 (MEL); Helms at Cambridge in 1899 (NSW); Morrisson at Nedlands in 1908 (NSW) and Claremont in 1909 (PERTH). *Senecio pinnatifolius* var. *latilobus* is still commonly present in bushland on Rottnest (Figure 6), City Beach and Bold Park, but is never found along roads, under pines or in other highly disturbed sites.

CONCLUSION

Senecio condylus is listed as a native species endemic to the Perth to Busselton region (AVH, 2015, Council of the Heads of Australian Herbaria, 2006 and WESTERN AUSTRALIAN HERBARIUM 1998 –). As can be seen from the preceding discussion the taxonomy of the *Senecio lautus*/ *S. pinnatifolius* complex has proven complex and difficult. The description of *Senecio condylus* and the correct placement of the other members of this complex by Ian Thompson has enabled at least a partial solution to the puzzle of the "Freeway Senecio" by separating

Figure 6. *Senecio pinnatifolius* var. *latilobus* in native vegetation on Rottnest Island, 2016 (type locality for variety).

it from other species present in the area.

Because of its late collection, preference for highly disturbed sites and recent recording in local bushland areas, it seems unlikely that this species is a native, but is more likely a recently arrived weed, probably from overseas. It is possibly part of the European *Senecio squalidus* L. complex (which includes plants allocated to *S. nebrodensis*), but we feel it is more likely of African origin. Unfortunately, the taxonomy of annual *Senecio* species in Southern Africa (Hilliard, 1977) is very complex and confused, which makes ready assignment of any potential weedy *Senecio* difficult. This is illustrated by the long drawn out debate about the native or naturalised status, differentiation from native Australian *Senecio* species and origin of the African Fireweed *S. madascariensis* Poir. in eastern Australia., which has only recently been resolved (Radford *et al.* 2000). The resolution of the origin of *Senecio condylus* requires a similar genetic, morphological and taxonomic comparison to annual African taxa of the genus *Senecio*.

Finally studies on the coastal populations of *Senecio pinnatifolius* in eastern Australia

(Roda *et al.* 2013) has demonstrated that coastal forms appear in several independent phylogenetic clades not a single taxonomic unit. If *Senecio condylus* is shown to be not a part of an exotic species complex then the question of its apparent recent origins within the *Senecio lautus/glossanthus* complex are also worthy of study. Fortunately the species does not appear to be highly invasive, although this may be changing with increased disturbance of remnants, and we have not yet noticed any hybrids in areas where it currently co-occurs with native *Senecio* species.

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OBITUARY

ALAN THOMAS NOTLEY

1928–2016

The Western Australian Naturalists' Club and Western Australia lost one of its most knowledgeable and respected conservationist/botanist/gardeners with the death in Perth on 23 February 2016 of Alan Notley at the age of 87. Alan was born in the Old Catton District of St Faiths, Norfolk, England on 10 April 1928 and his education, growing up and early adult life were impacted by the uncertainties of war and the consequent post-war social unrest that followed which led him to live much of his life in another hemisphere. Alan was aged eleven when World War 11 commenced. In many respects Alan's life had many similarities with that of my own father, Edgar Dell who was aged 13 when World War 1 began. These similarities and links between the two are expanded on further below. (Also for reference see: Edgar Dell Obituary 2010, *W.A. Naturalist* Volume 27: 184–191).

Celebrating 80th birthday at Glenbourne in 2010.

Alan was born into a horticultural background as his grandfather was head gardener on the estate of a wealthy family. When he was four Alan's parents moved from rented rooms to Wilks Farm, Sprowston, a house shared with the family of his father's brother who had a flower growing business operating from a field on nearby Wroxham Road. At the age of five Alan started school at Sprowston Primary School but when the family moved to a new bungalow at Spixworth the following year he attended Old Catton School.

In September 1939, Alan was due to commence at Sprowston Secondary School but his parents refused to send him there until

air raid shelters had been provided. These were completed by April 1940 and Alan started secondary school after the Easter holidays. Two years later, and a few days after the blitz on Norwich, he left school at the age of 14 to commence work in the City of Norwich Parks Department where his father worked. In 1944 at the age of 16 he moved to the Spixworth market garden of Stanley W. Hannent to assist in growing glasshouse tomatoes and other food crops as part of the war effort.

Almost a generation before, my father too grew up surrounded by plants as his father was a nurseryman who managed his own business, primarily responsible for the bedding plants, shrubs and trees of many private estates in London.

While still working on the market garden in June 1949, Alan noticed an advertisement that farm workers were needed in Australia so he went to see the Australian representative at the Norwich Labour Exchange. In late-January 1950 he received information from Australia House to say he was booked to sail from Glasgow to Fremantle on 14 February. Alan left Norwich by train on the afternoon of 13 February to travel via Edinburgh to Glasgow and sailed the next afternoon via the Suez Canal to Aden. Next stop was Colombo where he bought a bunch of bananas and a pineapple, the first he had eaten since

Alan (centre foreground) on Naturalists' Club excursion to the Darling Range in 1951.

the war started in 1939. He arrived in Fremantle on the afternoon of 19 March.

A quarter of a century before, my father had also seen advertised a call for workers in Western Australia and duly departed for Fremantle arriving there in 1924.

When Alan arrived in Fremantle he started work for Mr Fred Pound the landlord of the Cottesloe Hotel which required him to live on and undertake orchard work on the landlord's property at Roleystone. What a boon for a young man interested in plants and animals of a new country to be surrounded by bushland. This was a similar situation to that of my father who had taken employment on orchards in the Carmel/Bickley area not far from, and very similar to the environment experienced by Alan at Roleystone. I remember Alan telling me how important my father's water-colour paintings in the book *West Australian Wildflowers* were in helping him identify plant species that had been previously totally unfamiliar to him.

Shortly after arriving from England Alan joined the Naturalists' Club in 1950 while residing and working on the orchard in Croydon Road, Roleystone which was then an outer and largely bush Perth suburb which offered much to interest a keen young naturalist. Alan had bought a bicycle and once a month on Friday evening he would ride to Kelmscott to catch a train to attend the Club meetings at the W.A. Museum. He also took one Saturday off each month to attend Club excursions.

At this time the Club was governed by a veritable who's who of Perth's natural history expertise including Bert Main, Joe Gentilli, Barbara York (Main), Dom Serventy, Harry Butler, and Vincent Serventy together with a team of soon to become Club experts in a range of natural history fields. Alan joined this illustrious group as a Club Council Member from 1951–52.

At this time, Alan was evidently contributing information on plants to other botanists and in an article published on the distribution of *Pilostyles hamiltonii* in the *W. A. Naturalist* volume 3 page 23, G.G. Smith of the University of W.A. refers to specimens collected by Alan on the host plant *Daviesia rhombifolia* from Gosnells, between the Cascades and the Sixty Foot Falls.

Alan was more than just interested in plants and in 1951 at the age of 23 published a short paper titled "Red-winged Wren at Roleystone" in *W.A. Naturalist* volume 3 page 41.

In England Alan had also been interested in honey bees and had considerable expertise in bee husbandry having assisted his grandfather look after the bees on the estate where he had been head gardener. This expertise allowed Alan to get a different job and to travel inland to the eucalypt woodlands of the

Alan observing nature (photo Justin Notley).

southern wheatbelt where he was responsible for maintaining a large number of honey bee hives. This introduced him to a totally different flora and its associated fauna. Another great benefit to Alan was the fact that when the flowering season began to decline inland, the bees had to be moved to the sandplain north of Perth at the beginning of the flowering season there. Here again was a very different flora. In a matter of about only two years Alan was able to work closely with and become familiar with the flora and fauna of three distinctly different regions.

When the Honey Company was sold, Alan was offered a job at the Honey Pool but as this was mostly a labouring job he was not interested. Within a few days he obtained a position as a shop assistant with Wilson & Johns Nurserymen at their shop in Barrack Street in Perth (interestingly my father frequently bought fruit trees and other horticultural items from this business and as a young boy I would often accompany him. No doubt we would have been served by Alan!). His gardening and plant knowledge was in great demand to customers of the business. Alan obtained lodgings in Mount Hawthorn which meant he could renew his connections with the Naturalists Club and get to meetings and excursions.

By the middle of 1952 Alan had completed the requirement of working for two years in Australia and was free to move again. Having promised his mother that he would return to England after two years, he resigned from Wilson & Johns and for six

weeks frequented the docks and shipping offices in Fremantle hoping to get a job as a steward or deckhand on a ship sailing to England. Positions were few and he finally managed to get a position as deck-boy on a Norwegian oil tanker "The James Stove" which was enroute to Port Pirie and Melbourne to onload oil and then back empty to Bahrain to refill. Several months later the tanker was back in Sydney and Alan signed off. He booked a passage on the Italian liner "Oceania" which was sailing to Naples. From there he caught a train and arrived back in London.

After Alan returned to England in 1953 he continued his membership of the Naturalists' Club for several years until at least 1955. In a list of Club members published in the Club Journal in May 1953 his address was listed as "Heliopolis", Spixworth, Norwich, Norfolk and in the Journal for May 1955 his address was listed as "Fishley Cottage", Acle, Norfolk. Alan remained in England for sixteen years where he firstly worked as Nursery Manager for L.B. Rake Nurseries at Acle and then as manager for a retail seed merchant. When this was sold he managed to obtain the lease of the premises and with the help of his parents continued the business. He later commenced another highly successful horticultural business which he operated until he left England.

Alan hankered for the friends he had made in Western Australia and more importantly he missed the climate and the wonderful flora. So with his wife Lynette

Alan leading excursion at Kitty's Gorge, Serpentine National Park (photo Justin Notley).

and two young children (Justin 1 year and 7 months and Erica 7 months) he decided to return to Western Australia for good in September 1969.

Back in Western Australia, Alan began a series of jobs which involved mostly working with the growing of native plants. The new city of Rockingham south of Perth saw Alan undertaking much of the landscaping. The Pilbara was another major region that beckoned and the new iron-ore mining town of Goldsworthy saw Alan managing a plant nursery mostly specialising in the propagation of plants from the region as well as tropical trees suitable for street planting. The position included a house which provided comfortable air-conditioned accommodation for Alan and his young family. Their Landrover enabled them to explore the neighbouring country and visit the coast north of Port Hedland at weekends.

After two years in the Pilbara Alan decided he preferred to live back in Perth as he wanted something better for the children. The family moved back to their house in Safety Bay and Alan picked up several casual jobs including gardening at Garden City shopping centre.

In 1972 Alan's horticultural career received a large boost when he was invited to join Alan Bond's Sun City housing development at Yanchep as nurseryman. The house at Safety Bay was again rented out and the family moved to the company house at Yanchep. Shortly after, the Japanese company Tokyu Corporation became a major partner and Alan became manager of garden services which saw him managing the nursery and all the landscaping of the project.

I recall Alan inviting me to attend workshop meetings with him when executives of the Tokyu Corporation would present their ideas for future development which included investigating the potential of a resort for Japanese tourists arriving by plane to a dedicated company airport. During the workshop, I quietly conferred with Alan as to whether I should raise any concerns I might have as to exclusive use of an airport. I quickly learnt a bit about diplomacy when advised by Alan that the protocol was for us to listen and if we had concerns we would be afforded a separate workshop.

Alan married his second wife, Johanna Keith, the Deputy Principal of Governor Stirling Senior High School, in 1984 and they had a daughter Miriam.

In 1993 at the age of 65 Alan decided to retire from the position at Yanchep Sun City and concentrate on family and his volunteer work. However a lucrative opportunity arose in Brunei. Alan's son Justin, a landscape architect, had gained a contract to develop and landscape a new garden for the Sultan of Brunei which included the gardens for the Sultana's palace. The contract required

Daughter's wedding in 2011 (l-r Erica, Alan, Miriam and Justin).

gardens to be planted and to be in flower by a set date. They also had to be plants of particular colours. Naturally Alan agreed to undertake this project with Justin. Plants of the desired types were not available locally so they had to be acquired elsewhere and barged to Brunei. All was well and the gardens were flowering magnificently by the required date.

When Alan returned to Perth in 1969 he re-joined the Naturalists' Club and in 1983 was re-elected to Club Council and served in a number of roles, including three terms as President, over the next 24 years. Alan convinced his son Justin to join him as Club secretary between 1991 and 1993. Positions held by Alan after 1983 were as follows:

President: 1987–1988; 1991–1993; 1997–1999

Vice-President: 1984–1986; 1989–1990; 1999–2000

Secretary: 1995–1997

Council: 1983–1984; 1990–1991; 1993–1994; 2001–2007.

During the time that Alan held the positions listed above he undertook other important roles

within the Club. He was Convenor of the Junior Section from 1983 to 1985 and organised excursions to many places that permitted hands-on contact with plants and animals. He also edited the Club newsletter "Naturalist News" in 1989 and for a further eleven years from 1995–2006.

The building of the Yunderup Field Station on Culeenup Island in the Murray River delta in the 1980s was the most ambitious project undertaken by the Club. The biological richness of the delta islands had been demonstrated by the results of a number of surveys conducted there by members for more than ten years and the use of a field station would enhance such studies. Building a field station on an island involved much detailed planning and execution as well as the appropriate expertise. Fortunately the Club had these qualities available among its members and Otto Mueller led a team consisting of Gordon Elliott, Larry Fisher and Alan Notley with a host of other volunteers to successfully complete this enterprise.

Alan was a very active and enthusiastic Club member participating in or organising many excursions both locally as well as to more distant areas. He was especially renowned for his leadership and expertise and led members particularly to areas of high botanical diversity such as Mt Lesueur and the south coast. On many of these camping excursions he was accompanied by Johanna and Miriam firstly as a baby in a bassinet and then a growing child.

Alan was well known and respected as an expert Kings Park and Rottnest Island volunteer guide and introduced literally thousands of local as well as overseas visitors to the wonderful diversity and richness of Western Australia's flora and fauna.

At the end of any team or group activity which had been particularly successful, Alan was wont to remark, his distinctive accent emphasising his Norfolk grammar, "We done good"!

A very large gathering of family, friends and associates attended to pay tribute to Alan's lifetime of dedication and commitment, at his funeral service at St James Anglican Church, Alkimos on 26 February 2016.

Alan we salute you, *You done good.*

– JOHN DELL

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CLUB NEWS

Programme

General Meetings and Branch Meetings are held at various venues in Nedlands, Kalamunda, Rockingham and North Beach.
The Retired and Leisured Group meets on alternate Wednesdays at 10a.m.
Excursions and field days are planned from time to time and will be advertised in the Club's monthly newsletter "The Naturalist News".

THE WESTERN AUSTRALIAN NATURALIST
(Journal of the W.A. Naturalists' Club)

Editor
MR JOHN DELL

The Western Australian Naturalist publishes original data on all branches of natural science pertaining to Western Australia. Originals and two copies of manuscripts should be submitted to the Editor for review by two referees. Authors are requested to follow current editorial style. If possible, manuscripts should be submitted in Word format. High quality illustrations suitable for some reductions in size are preferred.

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